Imaging benign gynaecological conditions

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Abstract

Radiology continues to play an essential role in the management of benign gynaecological conditions. Multiple imaging modalities are utilised to investigate benign conditions: ultrasound; computed tomography and magnetic resonance imaging. Each modality has a different role in diagnosis, treatment selection and follow-up. This review discusses the different imaging modalities and their recommended roles in the imaging benign gynaecological conditions. The imaging findings of common benign female pelvic pathology are discussed and illustrated.

Keywords adenomyoma; diagnostic imaging; endometriosis; gynaecology; leiomyoma; ovarian cysts; ovarian torsion; pelvic inflammatory disease; teratoma

Imaging modalities

This review will discuss the various imaging modalities including: US, HSG, CT and MRI and how these are best employed in the imaging benign conditions of the female pelvis. We also review the imaging findings of common benign female pelvic pathology.

Ultrasound (US)

US is the primary imaging modality in the initial assessment of suspected gynaecological pathology. The advantages of US over other imaging modalities include: accessibility, relatively low cost, fast, portable and does not involve ionising radiation. Limitations of US include: operator dependency, limited views in obese patients and obscuration secondary to overlying bowel gas.

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Main indications for MRI of benign conditions

Organ	Indication
Uterus	Evaluation of congenital anomalies
	Evaluation of possible adenomyosis
	Evaluation of leiomyomas pre- and post-treatment
Adnexa	Characterisation of adnexal masses and PID

Table 1

Transabdominal US is best performed in patients with a full bladder to provide a sonic window for optimal views of the uterus and ovaries. For more detailed views of the endometrium and adnexa, a transvaginal (TV) US is essential. For TV US, the patient must have an empty bladder to allow close apposition of the probe with the pelvic organs. Colour Doppler is used to identify vascularity within endometrial or ovarian lesions. US can also assist in image guided fine-needle aspiration or biopsy, as well as percutaneous drainage, via a transabdominal or transvaginal route.

Sonohysterography is an US technique where saline or microbubble US contrast solution is injected into the uterine cavity via a small catheter inserted through the cervical canal. The procedure allows direct sonographic visualisation of the endometrial cavity to identify uterine pathology encroaching on the endometrial canal such as polyps and submucosal fibroids. The presence of free fluid in the pouch of Douglas post-procedure implies the patency of at least one fallopian tube.

Hysterosalpingogram

This is a fluoroscopic procedure commonly used to investigate infertility by assessing tubal patency and the endometrial cavity contour. A speculum is used to visualise the cervix and a thin tube passed into the endometrial cavity. A 2-ml balloon can be expanded within the cervix/lower endometrial cavity to create a seal. Water soluble contrast medium is them injected under direct fluoroscopic visualisation until spill of contrast medium is seen from the fallopian tubes into the peritoneal cavity. HSG is ideally performed within the first 10 days of the menstrual cycle to avoid the possibility of concurrent pregnancy. Contraindications include pregnancy and active pelvic infection.

Magnetic resonance imaging (MRI) and diffusion weighted imaging (DWI)

MRI is widely used to evaluate female pelvic pathology, offering excellent soft tissue contrast and spatial resolution as well as multi-planar capability. It is the imaging modality of choice to assess congenital anomalies of the uterus and vagina, characterise ovarian masses and evaluate uterine fibroids. See Table 1 for a summary of the main indications for MRI of the female pelvis.

T2-weighted images (T2WI) are helpful in demonstrating pathology which causes distortion of the normal anatomy and alter signal characteristics on MRI. Normal uterine signal characteristics on T2WI include a high signal intensity endometrium (<4

mm in thickness in the postmenopausal patient), a low signal intensity junctional zone (JZ) (normally measuring less than 8 mm) and an intermediate signal intensity myometrium. The cervix has a similar trilaminar appearance: high signal intensity endocervical canal with a low signal intensity cervical stroma and surrounding muscular layer of intermediate signal intensity.

T1-weighted images (T1WI) are mainly utilised in the benign setting for lesion characterisation as blood, proteinaceous products and fat are high signal intensity on T1WI. The application of fat suppression to T1WI will cause a fat-containing lesion to become low signal intensity (Figure 1), while proteinaceous fluid and blood products remain high signal intensity.

Post-contrast imaging is used in the evaluation of fibroids and the identification of uterine ovarian artery anastomoses, prior to uterine artery embolisation.

Diffusion weighted imaging (DWI) provides information about the free movement of water molecules, which is affected by tissue cellularity and cell membrane integrity. Different b-values are used to calculate the apparent diffusion coefficient (ADC). A high signal intensity on DWI and corresponding low signal intensity on ADC indicates restriction of movement of the water molecules, often secondary to high cellularity or intact membranes. Benign conditions such as tubo-ovarian abscess, dermoids, endometriomas, fibroids and fibromas cause restricted diffusion. However, most of these benign pathologies can be differentiated using other MRI sequences and the use of DWI may be non-contributory or even confusing, so should be interpreted with caution. Normal ovaries also demonstrate restricted diffusion, which can be useful in identifying ectopic ovaries in Mullerian duct anomalies.

Computed tomography (CT)

Contrast-enhanced CT of the abdomen and pelvis is performed in the portal venous phase, 70 seconds following an injection of intravenous low osmolar contrast medium. CT has a limited role in the imaging of the benign pelvic conditions due to poor soft tissue contrast. New multi-detector CT provides higher resolution imaging and when this is combined with multi-planar reformatting, there has been some improvement in delineating pelvic pathology, although MRI remains the gold standard. CT continues to have an increasing role in assessing the acutely unwell patient where the differential is broad and in evaluating post-surgical complications.

Uterus

Congenital uterine abnormalities

Most congenital anomalies of the female genital tract result from non-development, non-fusion or non-resorption of the Mullerian ducts that form the uterus, cervix and fallopian tubes. These anomalies are associated with menstrual disorders, infertility and obstetric complications. The possibility of such an anomaly should be considered when the uterus appears abnormal in size, shape or position on US imaging. MRI using T2WI is sensitive in the precise classification of anomalies and can reveal any associated urinary tract abnormalities.

Non-development or rudimentary development of the Mullerian ducts results in uterine agenesis or hypoplasia. In Mayer-Rokitansky-Kuster-Hauser (MRKH) syndrome, there is absence/hypoplasia of the uterus and upper vagina, with varying degrees of development of the lower vagina. Non-development or rudimentary development of only one the Mullerian ducts may lead to a unicornuate uterus.

Partial fusion of the Mullerian ducts results in a bicornuate uterus. MRI demonstrates an internal septum composed of myometrium dividing the two uterine horns and an intervening cleft in the external fundal myometrium. Non-fusion of the Mullerian ducts results in a didelphys uterus, with two separate uterine horns and cervices demonstrated on T2WI; a longitudinal vaginal septum is also present in 75% of cases.

Incomplete resorption of the fibrous septum between the two uterine horns results in a septate uterus. The septum may be partial, or complete extending to the external cervical os (Figure 2). It is important to make the differentiation between a bicornuate and a septate uterus, as the latter is associated with a higher rate of reproductive complications due to the poor vascularity of the fibrous septum. An arcuate uterus appears as a mild focal thickening of the fundal myometrium, with no associated fibrous septum.

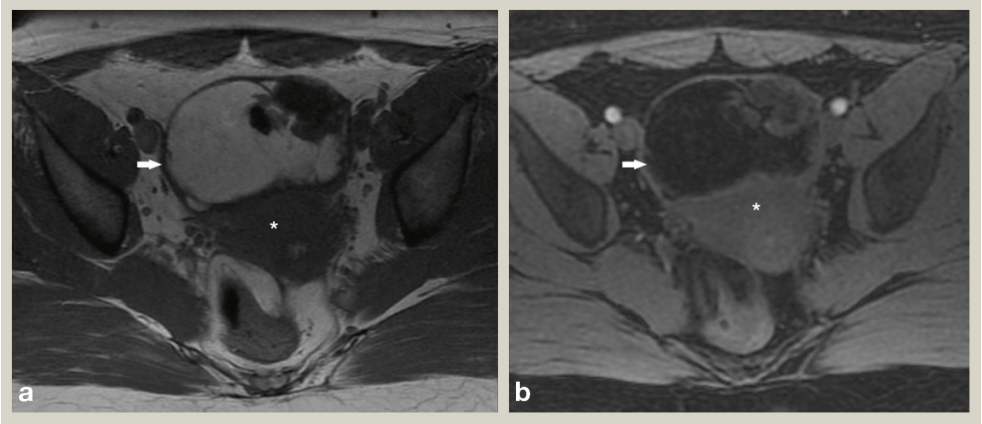

Figure 1 T1 (**a**) and T1 fat saturated (**b**) axial MRI images of a left ovarian dermoid (white arrow). Suppression of the high T1 signal intensity macroscopic fat on fat saturation sequences within the lesion is characteristic. *Uterus.